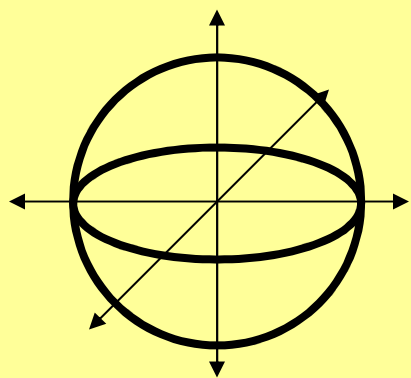


Valence Bond Theory:

Getting New Geometries From Atomic Orbitals

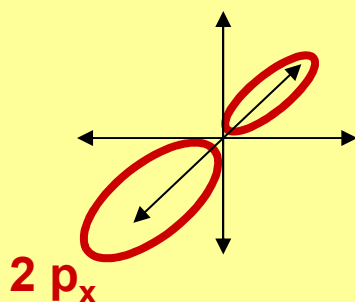
CH₄: Tetrahedral



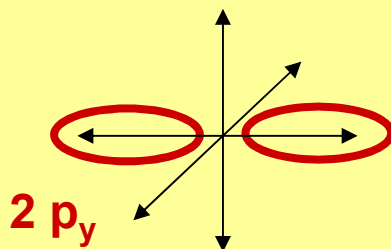
C

2 s orbital

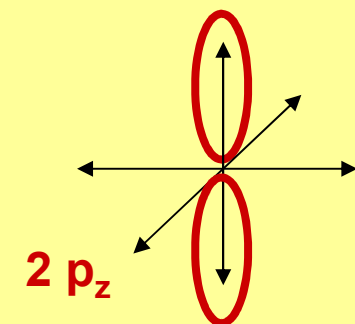
+



2 p_x

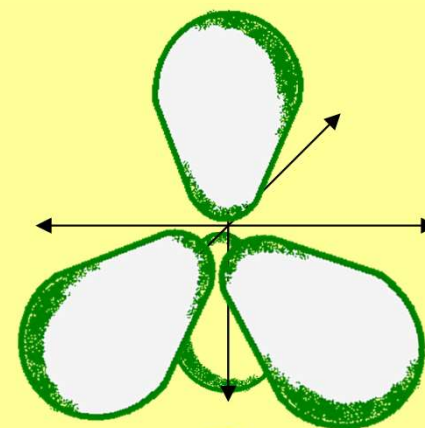
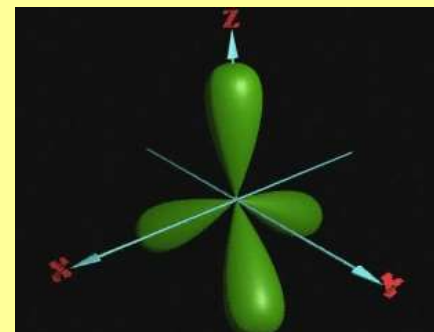


2 p_y



2 p_z

=



C

sp³ hybrid orbital

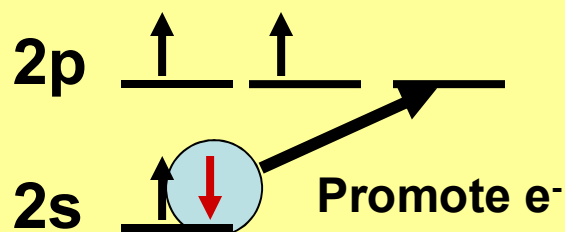
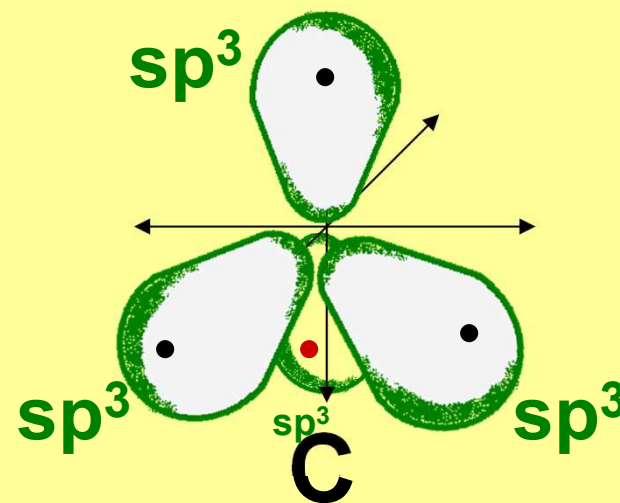


Valence Bond Theory:

ENERGIES

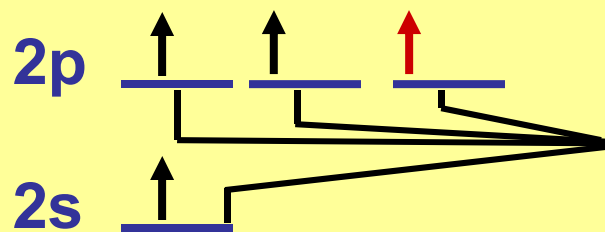
CH₄: *Tetrahedral* (sp^3)

C: *e⁻ configuration:* $1s^2 2s^2 2p^2$



1s $\uparrow\downarrow$
Ground State
E-Level Diag

2 unpaired e⁻ ⇒
2 possible bonds!



1s $\uparrow\downarrow$
Promoted State
E-Level Diag

4 unpaired e⁻ ⇒
4 possible bonds

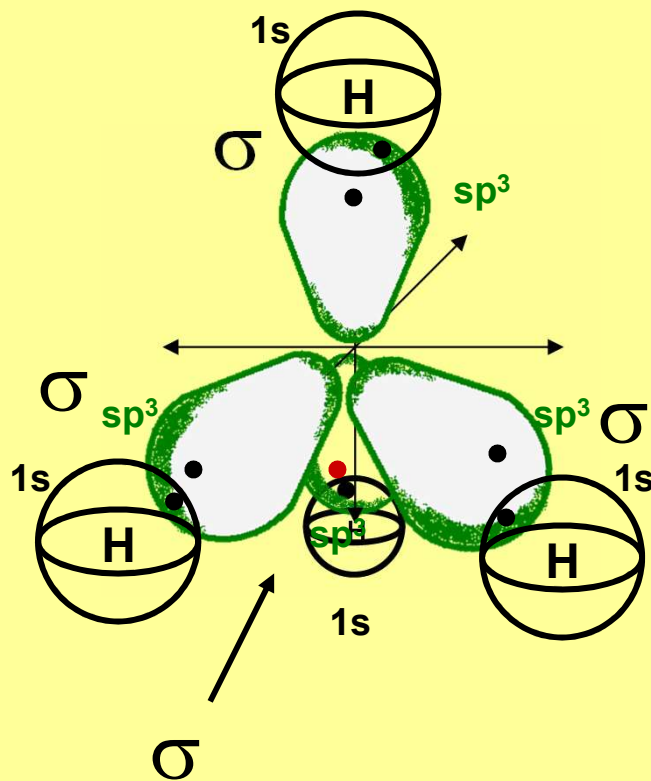


1s $\uparrow\downarrow$
Hybrid State
E-Level Diag

4 sp^3 hybrid levels
form 4 bonds



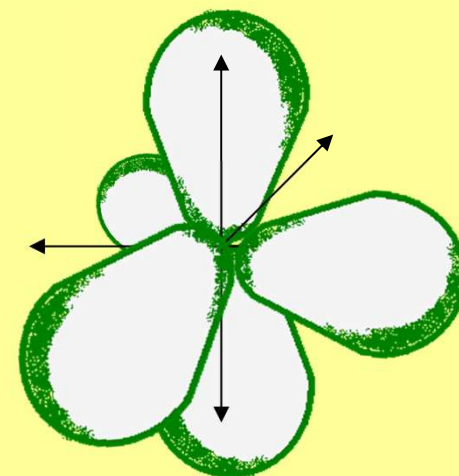
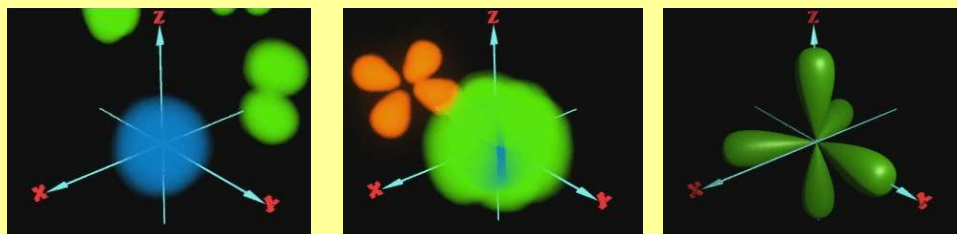
CH₄: Four σ Bonds



Valence Bond Theory:

Getting New Geometries From Atomic Orbitals

PCl₅: Trigonal Bipyramidal



P

sp³d hybrid orbital

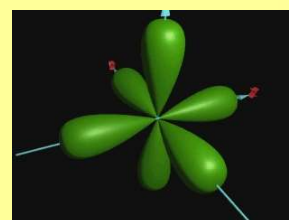
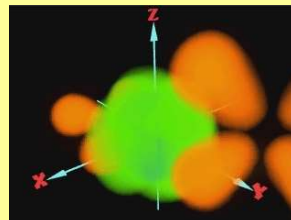
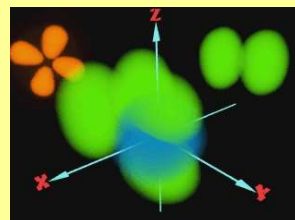
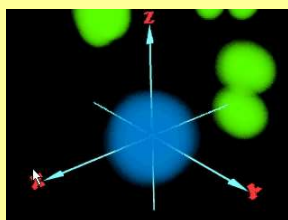
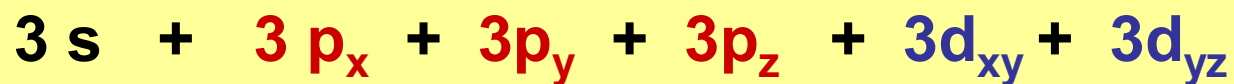
Trigonal Bi-pyramidal



Valence Bond Theory:

Getting New Geometries From Atomic Orbitals

SF₆: *Octahedral*



P

sp³d² hybrid orbital

Octahedral



Hybridization Summary

# Electron Regions	Electron Geometry	Atomic Orbitals	Hybridization
2	Linear	$s + p_x$	sp
3	Trigonal Planar	$s + p_x + p_y$	sp^2
4	Tetrahedral	$s + p_x + p_y + p_z$	sp^3
5	Trigonal Bipyramidal	$s + p_x + p_y + p_z + d_{xy}$	sp^3d
6	Octahedral	$s + p_x + p_y + p_z + d_{xy} + d_{yz}$	sp^3d^2

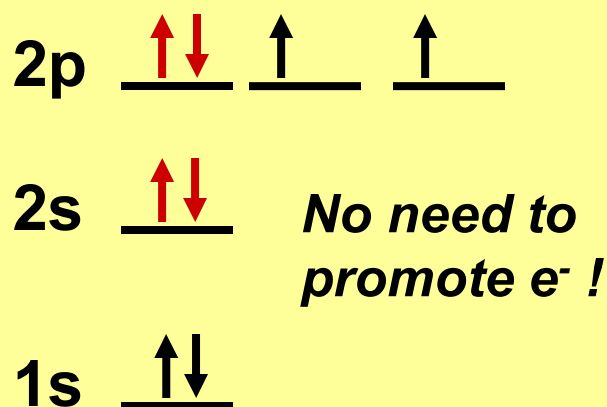
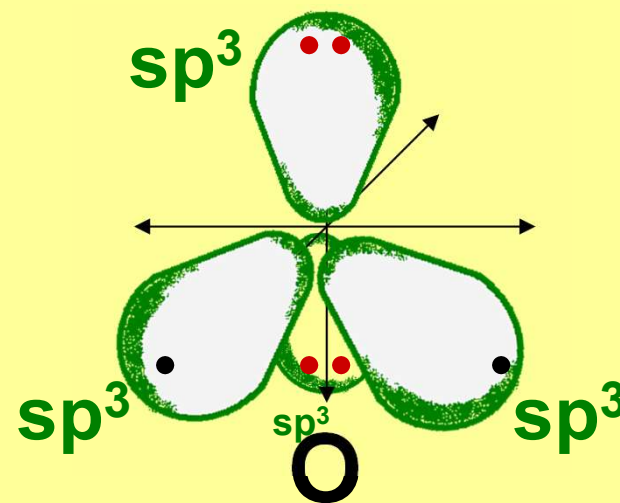


Valence Bond Theory:

ENERGIES

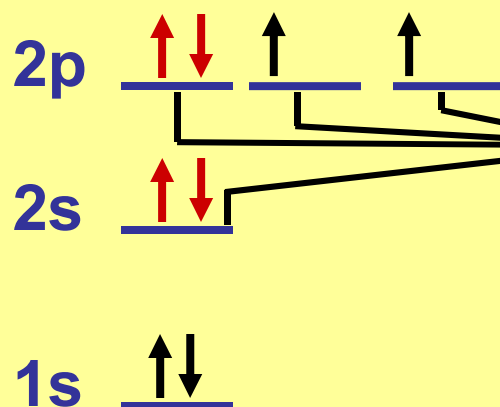
H₂O: *Tetrahedral* ^{IMPORTANT!!} (sp^3)

O e^- configuration: $1s^2 2s^2 2p^4$



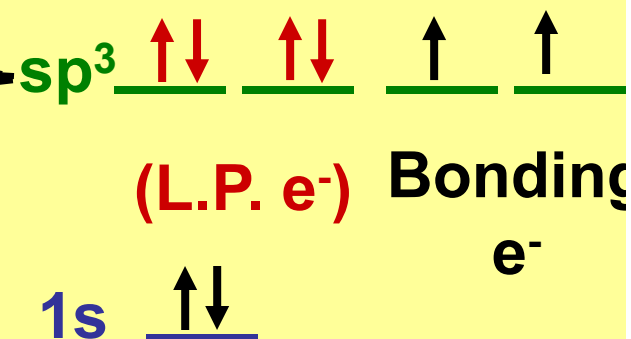
Ground State
E-Level Diag

**2 unpaired $e^- \Rightarrow$
2 possible bonds!**



Promoted State
E-Level Diag

Same as Ground
State E. diag.



Hybrid State
E-Level Diag

4 sp^3 hybrid levels
(2 bonds, 2 L.P.) 📢

H₂O: 2 bonds, 2 L.P.

